

WHAT IS CLAIMED IS:

1                    1.        A method of forming a bottom oxide layer in a trench structure, the  
2 method comprising:  
3                    (a) providing a semiconductor substrate and forming a trench structure on said  
4 semiconductor substrate;  
5                    (b) performing a the plasma-enhanced chemical vapor deposition (PECVD)  
6 process with tetraethylorthosilicate (TEOS) as a gas source to deposit an oxide layer on the  
7 bottom and sidewall of said trench structure and said semiconductor substrate; and  
8                    (c) removing said oxide layer on the sidewall of said trench structure  
9 substantially completely and said oxide layer on the bottom of said trench structure partially  
10 to define a remaining oxide layer as the bottom oxide layer.

1                    2.        The method according to claim 1 wherein the step (a) further  
2 comprises:  
3                    (a1) forming a pad oxide layer on the semiconductor substrate;  
4                    (a2) forming a silicon nitride layer on said pad oxide layer; and  
5                    (a3) removing said silicon nitride layer, said pad oxide layer and said  
6 semiconductor substrate partially to form said trench structure.

1                    3.        The method according to claim 2 wherein the step (a3) is performed by  
2 a photolithography and dry-etching process.

1                    4.        The method according to claim 1 wherein the trench structure has an  
2 aspect ratio between about 3.0 and about 4.0.

1                    5.        The method according to claim 1 wherein said plasma-enhanced  
2 chemical vapor deposition (PECVD) process is performed at a temperature of about 440°C to  
3 about 520°C.

1                    6.        The method according to claim 1 wherein a ratio of a thickness of said  
2 oxide layer deposited on the bottom of said trench structure to a thickness of said oxide layer  
3 deposited on the sidewall of said trench structure is between about 1.5 and about 2.3.

1                    7.        The method according to claim 1 wherein the step (c) is performed by  
2 a wet-etching process.

1                   8.       The method according to claim 7 wherein an etching selectivity of said  
2 oxide layer on the sidewall of said trench structure to said oxide layer on the bottom of said  
3 trench structure is between about 2.5 and about 3.

1                   9.       The method according to claim 1 wherein after the step (c), the steps of  
2 depositing and removing the oxide layer are repeated in sequence for allowing said bottom  
3 oxide layer to reach a required thickness.

1                   10.      The method according to claim 1 wherein said oxide layer comprises a  
2 silicon oxide layer.

1                   11.      A method of fabricating a trench-type power MOSFET, the method  
2 comprising:

3                   (a) providing a semiconductor substrate and forming a trench structure on the  
4 semiconductor substrate;

5                   (b) performing the plasma-enhanced chemical vapor deposition (PECVD)  
6 process with tetraethylorthosilicate (TEOS) as a gas source to deposit an oxide layer on the  
7 bottom and sidewall of said trench structure and said semiconductor substrate;

8                   (c) removing said oxide layer on the sidewall of said trench structure  
9 substantially completely and said oxide layer on the bottom of said trench structure partially  
10 to define the remaining oxide layer as a bottom oxide layer; and

11                  (d) forming the trench-type power MOSFET device in said trench structure.

1                   12.      The method according to claim 11 wherein the step (a) further  
2 comprises steps of:

3                   (a1) forming a pad oxide layer on said semiconductor substrate;

4                   (a2) forming a silicon nitride layer on said pad oxide layer; and

5                   (a3) removing said silicon nitride layer, said pad oxide layer and said  
6 semiconductor substrate partially to form said trench structure.

1                   13.      The method according to claim 12 wherein the step (a3) is performed  
2 by a photolithography and dry-etching process.

1                   14.      The method according to claim 11 wherein said trench structure has an  
2 aspect ratio between about 3.0 and about 4.0.

1                   15.     The method according to claim 11 wherein said plasma-enhanced  
2 chemical vapor deposition (PECVD) process is performed at a temperature of about 440°C to  
3 about 520°C.

1                   16.     The method according to claim 11 wherein a ratio of a thickness of  
2 said oxide layer deposited on the bottom of said trench structure to a thickness of said oxide  
3 layer deposited on the sidewall of said trench structure is between about 1.5 and about 2.3.

1                   17.     The method according to claim 11 wherein the step (c) is performed by  
2 a wet-etching process.

1                   18.     The method according to claim 17 wherein the etching selectivity of  
2 said oxide layer on the sidewall of said trench structure to said oxide layer on the bottom of  
3 said trench structure is between about 2.5 and about 3.

1                   19.     The method according to claim 11 wherein between the steps of (c)  
2 and (d), the steps of depositing and removing said oxide layer are repeated for allowing said  
3 bottom oxide layer to reach a required thickness.

1                   20.     The method according to claim 11 wherein said oxide layer comprises  
2 a silicon oxide layer.

1                   21.     A method of forming a bottom oxide layer in a trench structure, the  
2 method comprising:  
3                   providing a substrate including a trench having a bottom and a sidewall;  
4                   depositing an oxide layer on the bottom and sidewall of said trench by plasma-  
5 enhanced chemical vapor deposition (PECVD) process with tetraethylorthosilicate (TEOS) as  
6 a gas source at a temperature of about 440°C to about 520°C; and  
7                   removing said oxide layer on the sidewall of said trench substantially  
8 completely and said oxide layer on the bottom of said trench partially to form a remaining  
9 oxide layer as the bottom oxide layer on the bottom of said trench.

1                   22.     The method of claim 21 wherein said oxide layer is removed by a wet-  
2 etching process having a higher etching selectivity of said oxide layer on the sidewall of said  
3 trench to said oxide layer on the bottom of said trench.

1                    23.     The method of claim 22 wherein the etching selectivity of said oxide  
2     layer on the sidewall of said trench to said oxide layer on the bottom of said trench is between  
3     about 2.5 and about 3.